

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (currently amended) A method of embedding digital watermark information in a color image, said method comprising the steps of:

providing a color signal transformation matrix and an inverse color signal transformation matrix, the color signal transformation matrix transforming image data in a first colorimetric system, which expresses a predetermined color space by a combination of plural parameters, into image data in a second colorimetric system, which expresses the predetermined color space by a combination of other plural parameters, the inverse color signal transformation matrix carrying out inverse of the transformation;

adjusting the color signal transformation matrix by either [[of]] adding a digital watermark matrix to [[and]] or subtracting a digital watermark matrix [[to and]] from the color signal transformation matrix, the digital watermark matrix including an arbitrary numerical value of real number x, which represents the digital watermark information, as an entry [[thereof]] of the digital watermark matrix and satisfying a condition that a sum of respective entries in each row and in each column is [[all]] substantially equal to zero;

transforming the image data in the first colorimetric system into image data in the second colorimetric system with the adjusted color signal transformation matrix; and

inversely transforming the resulting image data in the second colorimetric system, which is obtained by the transformation, into the image data in the first colorimetric system with the inverse color signal transformation matrix, so as to embed the digital watermark information into the color image.

2. (currently amended) An embedding method in accordance with claim 1, wherein [[one of]] either the first colorimetric system [[and]] or the second colorimetric system is an RGB colorimetric system using three primary colors of light as parameters, [[and]] while the other [[of the first]] colorimetric system [[and the second colorimetric system]] is a YCbCr colorimetric system using a luminance signal and color difference signals as parameters.

3. (currently amended) An embedding method in accordance with claim 1, wherein the arbitrary numerical value of real number x is an arbitrary value in a range ~~[[of]]~~ not exceeding ~~[[less than]]~~ -0.1 and ~~[[not greater than]]~~ 0.1 .

4. (currently amended) An embedding method in accordance with claim 2, said method further comprising the step of:

carrying out either ~~[[one of]]~~ an underflow correction ~~[[and]]~~ or an overflow correction to cause an arbitrary pixel value to be an integer within a predetermined range in the process of inversely transforming the image data in the YCbCr colorimetric system, which is obtained by the transformation with the adjusted color signal transformation matrix, into the image data in the RGB colorimetric system by means of the inverse color signal transformation matrix.

5. (original) A decoding method to take a digital watermark out of image data with the digital watermark embedded therein, said method comprising the steps of:

calculating a difference matrix between watermark-embedded data, which is obtained by transforming a color image with a digital watermark embedded therein into color signals in a YCbCr colorimetric system, that is, a luminance signal and color difference signals, and watermark-free data, which is obtained by transforming an original image without the digital watermark embedded therein into color signals in the YCbCr colorimetric system, that is, a luminance signal and color difference signals;

decomposing the difference matrix into respective rows and calculating an arbitrary numerical value of real number x , which is supposed to represent the digital watermark information, with regard to each row; and

estimating a mean of the numerical values of real number x calculated with regard to the respective rows as the digital watermark information.

6. (original) A decoding method in accordance with claim 5, wherein the arbitrary numerical value of real number x , which is supposed to represent the digital watermark information, is calculated on the premise that an absolute value of a difference between entries in each row of the difference matrix is not less than a preset value.

7. (currently amended) A storage medium in which a program for embedding digital watermark information in a color image is stored in a computer readable manner, said program comprising:

a color signal transformation matrix that transforms image data in a first colorimetric system, which expresses a predetermined color space by a combination of plural parameters, into image data in a second colorimetric system, which expresses the predetermined color space by a combination of other plural parameters, and an inverse color signal transformation matrix that carries out inverse of the transformation;

the function of adjusting the color signal transformation matrix by either [[of]] adding a digital watermark matrix to [[and]] or subtracting a digital watermark matrix [[to and]] from the color signal transformation matrix, the digital watermark matrix including an arbitrary numerical value of real number x , which represents the digital watermark information, as an entry [[thereof]] of the digital watermark matrix and satisfying a condition that a sum of respective entries in each row and in each column is [[all]] substantially equal to zero;

the function of transforming the image data in the first colorimetric system into image data in the second colorimetric system with the adjusted color signal transformation matrix; and

the function of inversely transforming the resulting image data in the second colorimetric system, which is obtained by the transformation, into the image data in the first colorimetric system with the inverse color signal transformation matrix, so as to embed the digital watermark information into the color image.

8. (original) A storage medium in which a program for taking a digital watermark out of image data with the digital watermark embedded therein is stored in a computer readable manner, said program comprising the functions of:

calculating a difference matrix between watermark-embedded data, which is obtained by transforming a color image with a digital watermark embedded therein into color signals in a YCbCr colorimetric system, that is, a luminance signal and color difference signals, and watermark-free data, which is obtained by transforming an original image without the digital watermark embedded therein into color signals in the YCbCr colorimetric system, that is, a luminance signal and color difference signals;

decomposing the difference matrix into respective rows and calculating an arbitrary numerical value of real number x , which is supposed to represent the digital watermark information, with regard to each row; and

estimating a mean of the numerical values of real number x calculated with regard to the
respective rows as the digital watermark information.